

SPT	Field data from Standard Penetration Test (SPT)
BPT	Field data from Becker Penetration Test (BPT)
qc	Field data from Cone Penetration Test (CPT)
fc	Friction from CPT testing
Gamma	Total unit weight of soil
Gamma'	Effective unit weight of soil
Fines	Fines content [%]
D50	Mean grain size
Dr	Relative Density
sigma	Total vertical stress [tsf]
sigma'	Effective vertical stress [tsf]
sigC'	Effective confining pressure [tsf]
rd	Stress reduction coefficient
CSR	Cyclic stress ratio induced by earthquake
fs	User request factor of safety, apply to CSR
w/fs	with user request factor of safety inside
CSRfs	CSR with user request factor of safety
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksigma	Overburden stress correction factor for CRR7.5
CRRV	CRR after overburden stress correction, $CRRV = CRR7.5 * Ksigma$
MSF	Magnitude scaling factor for CRR (M=7.5)
CRRm	After magnitude scaling correction $CRRm = CRRV * MSF$
F.S.	Factor of Safety against liquefaction $F.S. = CRRm / CSRfs$
Cebs	Energy Ratio, Borehole Dia., and Sample Method Corrections
Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, $(N1)60 = SPT * Cr * Cn * Cebs$
d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, $(N1)60f = (N1)60 + d(N1)60$
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, $qc1f = qc1 + dqc1$
qc1n	CPT after normalization in Robertson's Method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
IC	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after seattlement fines corrections
ec	Volumetric strain for saturated sands
ds	Settlement in each Segment dz
dz	Segment for calculation, $dz = 0.050$ ft
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for dry sands, $ec = Cec * ec7.5$
NoLiq	No-Liquefy Soils

References:

- NCEER workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.
- SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.

APPENDIX D

General Grading Specifications

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1. GENERAL INTENT

These specifications present general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of subdrains, and excavations. The recommendations contained in the geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations of the geotechnical report.

2. EARTHWORK OBSERVATION AND TESTING

Prior to the commencement of grading, a qualified geotechnical consultant (soils engineer and engineering geologist, and their representatives) shall be employed for the purpose of observing earthwork and testing the fills for conformance with the recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observation so that he may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep him apprised of work schedules and changes so that he may schedule his personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If in the opinion of the consultant, unsatisfactory conditions, such as questionable soil, poor moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be topped until the conditions are rectified. Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society of Testing and Materials tests method ASTM D 1557-78.

3.0 PREPARATION OF AREAS TO BE FILLED

3.1 Clearing and Grubbing: All brush, vegetation and debris shall be removed or piled and otherwise disposed of.

3.2 Processing: The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3.3 Overexcavation: Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such a depth that the surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, approved by the consultant.

3.4 Moisture Conditioning: Overexcavated and processed soils shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near optimum.

3.5 Recompanction: Overexcavated and processed soils which have been properly mixed and moisture- conditioned shall be recompancted to a minimum relative compaction of 90 percent.

3.6 Benching: Where fills are to be placed on ground with slopes steeper than 5: 1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm material, and shall be approved by the consultant. Other benches shall be excavated in firm material for a minimum width of 4 feet. Ground sloping flatter than 5 : 1 shall be benched or otherwise overexcavated when considered necessary by the consultant.

3.7 Approval: All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the consultant prior to fill placement.

4.0 FILL MATERIAL

4.1 General: Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the consultant. Soils of poor gradation, expansion, or strength characteristics shall be placed in areas designated by consultant or shall be mixed with other soils to serve as satisfactory fill material.

4.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fills, unless the location, materials, and disposal methods are specifically approved by the consultant. Oversize disposal operations shall be such that nesting of oversize material does not occur,

and such that the oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet vertically of finish grade or within the range of future utilities or underground construction, unless specifically approved by the consultant.

4.3 Import: If importing of fill material is required for grading, the import material shall meet the requirements of Section 4. 1.

5.0 FILL PLACEMENT AND COMPACTION

5.1 Fill Lifts: Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 6 inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

5.2 Fill Moisture: Fill layers at a moisture content less than optimum shall be watered and mixed, and wet fill layers shall be aerated by scarification or shall be blended with drier material. Moisture-conditioning and mixing of fill layers shall continue until the fill material is at a uniform moisture content or near optimum.

5.3 Compaction of Fill: After each layer has been evenly spread, moisture conditioned, and mixed, it shall be uniformly compacted to not less than 90 percent of maximum dry density. Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or of proven reliability, to efficiently achieve the specified degree of compaction.

5.4 Fill Slopes: Compaction of slopes shall be accomplished, in addition to normal compacting procedures, by backfilling of slopes with sheepsfoot rollers at frequent increments of 2 to 3 feet in fill elevation gain, or by other methods producing satisfactory results. At the completion of grading, the relative compaction of the slope out to the slope face shall be at least 90 percent.

5.5 Compaction Testing: Field tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at an interval not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of embankment.

6.0 SUBDRAIN INSTALLATION

Subdrain systems, if required, shall be installed in approved ground to conform to the approximate alignment and details shown on the plans or herein. The subdrain location or materials shall not be changed or modified without the approval of the consultant. The consultant, however, may recommend and upon approval, direct changes in subdrain line, grade or material. All subdrains should be surveyed for line and grade after installation, and sufficient time shall be allowed for the surveys, prior to commencement of filling over the subdrains.

7.0 EXCAVATION

Excavation and cut slopes will be examined during grading. If directed by the consultant, further excavation or overexcavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

8.0 TRENCH BACKFILLS

8.1 Supervision: Trench excavations for the utility pipes shall be backfilled under engineering supervision.

8.2 Pipe Zone: After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

8.3 Fill Placement: The onsite materials, or other soils approved by the engineer, shall be watered and mixed as necessary prior to placement in lifts over the sand backfill.

8.4 Compaction: The controlled backfill shall be compacted to at least 90 percent of the maximum laboratory density as determined by the ASTM compaction method described above.

8.5 Observation and Testing: Field density tests and inspection of the backfill procedures shall be made by the soil engineer during backfilling to see that the proper moisture content and uniform compaction is being maintained. The contractor shall provide test holes and exploratory pits as required by the soil engineer to enable sampling and testing.

Attachment No. 4
Summary of Mitigation Measures

<u>Description of Impact</u>	<u>Mitigation Measure</u>
Unstable soil conditions	GEO 1 The grading plan prepared for the new proposed project shall contain the recommendations included in the Geotechnical Engineering Report for the site prepared by Soil Pacific, Inc., dated July 2004 and updated July 2008. These recommendations shall be implemented in the design of the project and include measures associated with site preparation, fill placement and compaction, dewatering, seismic design features, excavation and shoring requirements, foundation design, concrete slabs and pavement, cement type, surface drainage, trench backfill, and geotechnical observation.
Grading and excavation around existing abandoned oil wells	HAZ 1 The developer shall consult with DOGGR to determine if plug or re-plug of existing abandoned oil wells is necessary. Prior to the issuance of grading permits, the developer shall submit evidence of consultation with DOGGR indicating wells have been plugged or abandoned to current DOGGR standards.
Grading and excavation around existing abandoned oil wells	HAZ 2 In the event that abandoned oil wells are damaged during construction, construction activities shall cease in the immediate vicinity immediately. Remedial plugging operations would be required to re-plug the affected wells to current Department of Conservation specifications. Depending on the nature of soil contamination, if any, appropriate agencies shall be notified (e.g. City of Huntington Beach Fire Department). The developer shall ensure proper implementation for the re-abandonment operation in compliance with all applicable laws and regulations.